1   REGULATION **5.22**   *Procedures for Determining the Maximum Ambient Concentration of*
2   *a Toxic Air Contaminant*

3   **Air Pollution Control District of Jefferson County**
4   **Jefferson County, Kentucky**

5   **Relates To:** KRS Chapter 77 Air Pollution Control
6   **Pursuant To:** KRS Chapter 77 Air Pollution Control
7   **Necessity and Function:** KRS 77.180 authorizes the Air Pollution Control Board to adopt and
8   enforce all orders, rules, and regulations necessary or proper to accomplish the purposes of KRS
9   Chapter 77. This regulation establishes the procedures for determining the maximum concentration
10   of a toxic air contaminant in the ambient air.

11   SECTION 1   **Determining the Maximum Ambient Concentration of a Toxic Air Contaminant**
12   1.1   The maximum ambient concentration of a toxic air contaminant determined using one of the
13   procedures in Sections 2 to 5 shall be used to determine compliance with the ambient levels
14   for environmental acceptability (EA levels) established in Regulation 5.21 *Environmental*
15   *Acceptability for Toxic Air Contaminants.*
16   1.2   For intermittent emissions, the average emission rate may be used to determine the maximum
17   ambient concentration if the average rate is not less than 10% of the maximum hourly rate.
18   Intermittent emissions are emissions that are not allowed to be emitted continuously for the
19   entire length of the time specified in Regulation 5.20 *Methodology for Determining*
20   *Benchmark Ambient Concentration of a Toxic Air Contaminant* as the applicable averaging
21   time for a benchmark ambient concentration.
22   1.3   Each procedure in Sections 2 to 5 represents an acceptable method for determining the
23   maximum ambient concentration of a toxic air contaminant, although there are stated
24   limitations for the use of the Tier 2 procedure. In general, the intent is that the Tier 1
25   procedure is the most simple to use, requires the least amount of process- and process
26   equipment-specific information, and provides the most conservative maximum ambient
27   concentration; proceeding on a continuum, the Tier 4 procedure is the most complex to use,
28   requires the greatest amount of process- and process equipment-specific information, and
29   provides the least conservative maximum ambient concentration. The following is a brief
30   description of the four procedures:
31   1.3.1   Tier 1 - Table 1: Simple Factor for Determining Maximum Ambient Concentration: The
32   allowed emission rate for the appropriate averaging time for the specific toxic air
33   contaminant is divided by a factor from the table to give the maximum ambient
34   concentration.
35   1.3.2   Tier 2 - Table 2: Annual Factor: The allowed hourly emission rate is divided by the
36   appropriate annual factor from the table to give the maximum ambient concentration.
37   The annual factor from the table depends on the building height, stack height-to-building
38   height ratio, and the distance to the closest secured property line, and the annual factor
39   from the table may be adjusted depending on the averaging time of the benchmark
40   ambient concentration for the specific toxic air contaminant.
41   1.3.3   Tier 3 - SCREEN3 and TSCREEN Models: The output of these screening models is the
42   maximum hourly ambient concentration. The maximum hourly ambient concentration

43   may be multiplied by an adjustment factor depending on the averaging time of the
44   benchmark ambient concentration for the specific toxic air contaminant. The models
45   contain different algorithms based upon the type of release, for example, stack or
46   fugitive. Basic dispersion modeling parameters are required, such as building height and
47   dimensions, stack height, stack diameter, exhaust gas flow rate, exhaust gas temperature,
48   and emission rate for a stack emission.

49   1.3.4   Tier 4 - EPA-Approved Dispersion Model: The output of these highly complex models
50   is the maximum ambient concentration for the identified averaging time, which is set
51   within the model depending on the averaging time of the benchmark ambient
52   concentration for the specific toxic air contaminant. The models contain different
53   algorithms based upon the type of release, for example, stack or fugitive. Detailed
54   dispersion modeling parameters are required.

55   **SECTION 2**   **Tier 1 - Table 1: Simple Factor for Determining Maximum Ambient**
56   **Concentration**

57   2.1   The maximum concentration of a toxic air contaminant from a process or process equipment
58   in the ambient air may be determined by using the appropriate factor from Table 1 and the
59   applicable Equation 1 to 4. The appropriate factor is determined by the averaging time for
60   a specific toxic air contaminant, which is established in Regulation 5.20. The calculated
61   maximum concentration is then used in determining compliance with the EA levels in
62   Regulation 5.21 by using the applicable equation in Regulation 5.21 section 2.2, 2.5, or 2.8.
63   If Table 1 contains two factors for a benchmark ambient concentration averaging time, then
64   the factor that results in the greater maximum concentration shall be used.

65   2.2   Table 1 *Simple Factor for Determining Maximum Concentration* reads as follows:

66   **Table 1**
67   **Simple Factor for Determining Maximum Ambient Concentration**

BAC[1] Averaging Time	Annual Factor (F_A)[2]	24-Hour Factor (F_{24})[3]	8-Hour Factor (F_8)[4]	1-Hour Factor (F_1)[5]
Annual	480			0.54
24 hours		0.12		0.05
8 hours			0.02	0.02
1 hour				0.001

75   Notes for Table 1:
76   [1]   BAC is the benchmark ambient concentration of a toxic air contaminant as
77   determined pursuant to Regulation 5.20.
78   [2]   The Annual Factor F_A is in units of (lb/year)/(μg/m^3). Use Equation 1.
79   [3]   The 24-Hour Factor F_{24} is in units of (lb/24 hours)/(μg/m^3). Use Equation 2.
80   [4]   The 8-Hour Factor F_8 is in units of (lb/8 hours)/(μg/m^3). Use Equation 3.

81   [5]   The 1-Hour Factor F_1 is in units of $(lb/1\ hour)/(\mu g/m^3)$. Use Equation 4.

82

$$Maximum\ Concentration_{ij} = \frac{Allowed\ annual\ emission_{ij}}{F_A} \qquad Equation\ 1$$

83

$$Maximum\ Concentration_{ij} = \frac{Allowed\ 24\text{-}hour\ emission_{ij}}{F_{24}} \qquad Equation\ 2$$

84

$$Maximum\ Concentration_{ij} = \frac{Allowed\ 8\text{-}hour\ emission_{ij}}{F_8} \qquad Equation\ 3$$

85

$$Maximum\ Concentration_{ij} = \frac{Allowed\ 1\text{-}hour\ emission_{ij}}{F_1} \qquad Equation\ 4$$

86   Where: i =   an individual toxic air contaminant, from
87   j =   an individual process or process equipment,
88   Allowed emission is in units of pounds per the applicable time period,
89   and
90   Maximum Concentration is in units of $\mu g/m^3$.

91   SECTION 3   **Tier 2 - Table 2:   Annual Factor for Determining Maximum Ambient**
92   **Concentration**
93   3.1   The maximum concentration of a toxic air contaminant from a process or process equipment
94   in the ambient air may be determined by using the appropriate annual factor from Table 2
95   (adjusted if appropriate) and Equation 5. The calculated maximum concentration is then
96   used in determining compliance with the EA levels in Regulation 5.21 by using the
97   applicable equation in Regulation 5.21 section 2.2, 2.5, or 2.8.
98   3.2   The use of Table 2 requires information about the dispersion characteristics of the source of
99   emissions, namely, the distance to the nearest secured property line, the height of the stack,
100   and, as described in section 3.7.2, the height of the influential building.
101   3.3   Table 2 shall not be used if any of the following provisions applies:
102   3.3.1   The stack height is less than 10 feet or the emission is a fugitive emission,
103   3.3.2   The influential building height is more than 100 feet,
104   3.3.3   There are terrain elevations that are more than 25% of the discharging stack height within
105   a distance of 500 feet from the stack, or
106   3.3.4   The analysis is for an elevated receptor, for example, a hospital air intake.
107   3.4   The annual factor value derived from Table 2 is the ratio of the annual averaged hourly
108   emission rate divided by the maximum annual ambient impact, in units of $(lbs/hr)/(\mu g/m^3)$.
109   3.5   The annual factor shall be adjusted if the averaging time of the benchmark ambient
110   concentration (BAC) for the specific toxic air contaminant as determined pursuant to
111   Regulation 5.20 is different than annual. This adjustment is done as follows:
112   3.5.1   24-hr factor $(lbs/hr)/(\mu g/m^3)$ = annual factor $\otimes$ 0.091.
113   3.5.2   8-hr factor $(lbs/hr)/(\mu g/m^3)$ = annual factor $\otimes$ 0.046.

114 3.5.3 1-hr factor (lbs/hr)/(μg/m^3) = annual factor $\otimes$ 0.02.
115 3.6 Determine the maximum concentration. This is done by using the allowed hourly emission
116 limit (lb/hr), taking into account the intermittent emission provision of section 1.3, for a toxic
117 air contaminant from a process or process equipment; the annual factor as derived from
118 Table 2 and, if appropriate, making the adjustment pursuant to section 3.5; and performing
119 the calculation in Equation 5. The resulting maximum concentration is in units of μg/m^3:
120

$$Maximum\ Concentration_{ij} = \frac{Allowed\ 1-hour\ emission_{ij}}{annual\ (adjusted)\ factor} \qquad Equation\ 5$$

121 Where: i = an individual toxic air contaminant, from
122 j = an individual process or process equipment, and
123 annual (adjusted) factor is the annual factor derived from Table 2, including
124 any adjustment required by section 3.5.
125 3.7 Instructions for deriving the annual factor from Table 2 are as follows:
126 3.7.1 Determine the height of the discharging stack from ground level in feet (H$_s$).
127 3.7.2 Determine the height of the influential building in feet (H$_b$). This is done by first
128 identifying all buildings, including buildings on-site and off-site, located within a
129 distance of 5 times their height from the discharging stack. Then, determine which
130 building is the highest. This is the influential building, with height (H$_b$) in feet. If the
131 stack is not attached to a building, then a building height of 40% of the stack height shall
132 be assumed.
133 3.7.3 Determine the ratio of the stack height to the influential building height by dividing the
134 stack height, in feet, by the influential building height, in feet, H$_s$ /H$_b$.
135 3.7.4 Determine the minimum distance, in feet, from the discharging stack to the secured
136 property line. If there is no secured property line, then a distance of 25 feet shall be used.
137 3.7.5 Determine the appropriate annual factor from Table 2. This is done by selecting the
138 column with the appropriate influential building height and H$_s$ /H$_b$ ratio, and selecting the
139 row with the appropriate minimum distance to the secured property line.
140 3.7.5.1 If the influential building height is between values in the column headings, then use
141 the lower value or interpolate between values in the column headings.
142 3.7.5.2 If H$_s$ is less than H$_b$, then set the influential building height equal to the stack height
143 and use the 1.25 H$_s$ /H$_b$ column.
144 3.7.5.3 If H$_s$ /H$_b$ is between 1 and 1.25, then select the 1.25 column.
145 3.7.5.4 If H$_s$ /H$_b$ is between 1.25 and 1.75, then use the 1.25 column or interpolate between
146 the 1.25 and 1.75 columns.
147 3.7.5.5 If H$_s$ /H$_b$ is between 1.75 and 2.5, then use the 1.75 column or interpolate between
148 the 1.75 and 2.5 columns.
149 3.7.5.6 If H$_s$ /H$_b$ is greater than or equal to 2.5, then use the 2.5 column.
150 3.7.5.7 If the minimum distance to the secured property line is between 2 distances in the
151 row headings, then use the lower value, for example, if the distance is 250 feet, then
152 use the 200 foot distance row in Table 2.

153   3.5   Table 2 *Annual Factor* reads as follows:

154   **Table 2 Annual Factor**

	Bldg Ht		10			20			30			40	
	H_s/H_b	1.25	1.75	2.50	1.25	1.75	2.50	1.25	1.75	2.50	1.25	1.75	2.50
	Stck Ht	12.5	17.5	25	25	35	50	37.5	52.5	75	50	70	100
D	25	0.0085	0.022	0.159	0.032	0.084	0.679	0.075	0.220	1.603	0.152	0.421	2.941
I	50	0.0087	0.022	0.159	0.032	0.084	0.679	0.075	0.220	1.603	0.152	0.421	2.941
S	75	0.0096	0.022	0.159	0.032	0.084	0.679	0.075	0.220	1.603	0.152	0.421	2.941
T	100	0.011	0.023	0.159	0.033	0.084	0.679	0.075	0.220	1.603	0.152	0.421	2.941
A	200	0.020	0.040	0.159	0.042	0.084	0.679	0.082	0.220	1.603	0.157	0.421	2.941
N	300	0.030	0.053	0.178	0.059	0.116	0.679	0.099	0.221	1.603	0.174	0.421	2.941
C	400	0.040	0.065	0.171	0.077	0.140	0.679	0.126	0.268	1.603	0.200	0.421	2.941
E	500	0.051	0.077	0.189	0.094	0.164	0.679	0.153	0.318	1.603	0.243	0.505	2.941
	600	0.063	0.091	0.222	0.112	0.188	0.746	0.181	0.368	1.603	0.287	0.588	2.941
F	700	0.075	0.104	0.241	0.130	0.211	0.812	0.208	0.413	1.603	0.328	0.664	2.941
T	800	0.089	0.119	0.257	0.148	0.235	0.768	0.235	0.459	1.608	0.370	0.740	2.941
	900	0.103	0.134	0.264	0.167	0.258	0.770	0.261	0.502	1.672	0.411	0.812	2.941
	1000	0.119	0.151	0.272	0.187	0.282	0.800	0.289	0.545	1.786	0.452	0.883	2.959
	1500	0.209	0.245	0.318	0.290	0.406	1.080	0.428	0.756	1.953	0.654	1.214	3.521
	2000	0.311	0.350	0.383	0.408	0.539	1.256	0.573	0.965	2.304	0.861	1.534	3.731

173   **Table 2 Annual Factor (Con't)**

	Bldg Ht		50			60			70			80	
	H_s/H_b	1.25	1.75	2.50	1.25	1.75	2.50	1.25	1.75	2.50	1.25	1.75	2.50
	Stck Ht	62.5	87.5	125	75	105	150	87.5	123	175	100	140	200
D	25	0.263	0.736	4.630	0.412	1.114	6.098	0.606	1.656	8.621	0.839	2.242	8.333
I	50	0.263	0.736	4.630	0.412	1.114	6.098	0.606	1.656	8.621	0.839	2.242	8.333
S	75	0.263	0.736	4.630	0.412	1.114	6.098	0.606	1.656	8.621	0.839	2.242	8.333
T	100	0.263	0.736	4.630	0.412	1.114	6.098	0.606	1.656	8.621	0.839	2.242	8.333
A	200	0.266	0.736	4.630	0.413	1.114	6.098	0.606	1.656	8.621	0.839	2.242	8.333
N	300	0.282	0.736	4.630	0.426	1.114	6.098	0.614	1.656	8.621	0.845	2.242	8.333
C	400	0.312	0.736	4.630	0.455	1.114	6.098	0.641	1.656	8.621	0.868	2.242	8.333
E	500	0.351	0.743	4.630	0.498	1.114	6.098	0.683	1.656	8.621	0.909	2.242	8.333
	600	0.409	0.838	4.630	0.545	1.114	6.098	0.741	1.656	8.621	0.967	2.242	8.333
F	700	0.468	0.951	4.717	0.625	1.269	6.250	0.808	1.672	8.621	1.040	2.242	8.333
T	800	0.528	1.064	4.803	0.705	1.429	6.410	0.901	1.825	8.621	1.111	2.242	8.333
	900	0.585	1.168	4.854	0.781	1.572	6.579	1.000	2.016	8.621	1.235	2.488	9.091
	1000	0.644	1.276	4.950	0.861	1.724	6.849	1.101	2.203	9.091	1.359	2.732	10.000
	1500	0.924	1.761	5.376	1.232	2.404	7.042	1.577	3.106	9.615	1.953	3.846	11.905
	2000	1.205	2.222	5.882	1.603	3.049	7.353	2.041	3.968	9.615	2.525	4.808	12.821

192   **Table 2 Annual Factor (Con't)**

	Bldg Ht		90			100	
	H_s / H_b	1.25	1.75	2.50	1.25	1.75	2.50
	Stck Ht	113	158	225	125	175	250
D	25	1.126	3.049	13.514	1.458	3.876	14.286
I	50	1.126	3.049	13.514	1.458	3.876	14.286
S	75	1.126	3.049	13.514	1.458	3.876	14.286
T	100	1.126	3.049	13.514	1.458	3.876	14.286
A	200	1.126	3.049	13.514	1.458	3.876	14.286
N	300	1.129	3.049	13.514	1.458	3.876	14.286
C	400	1.147	3.049	13.514	1.475	3.876	14.286
E	500	1.185	3.049	13.514	1.506	3.876	14.286
	600	1.244	3.049	13.514	1.563	3.876	14.286
F	700	1.316	3.049	13.514	1.634	3.876	14.286
T	800	1.404	3.049	13.514	1.730	3.876	14.286
	900	1.502	3.086	13.514	1.832	3.876	14.286
	1000	1.634	3.289	13.514	1.931	3.876	14.286
	1500	2.358	4.505	15.152	2.778	5.208	16.129
	2000	3.049	5.618	16.129	3.597	6.494	18.519

Notes for Table 2:
    Bldg Ht is the building height, in feet,
    H_s / H_b is the ratio of the stack height to the building height,
    Stack Ht is the stack (or release) height, in feet, and
    The annual factor is in units of $(lbs/hr)/(\mu g/m^3)$.

SECTION 4   Tier 3 - SCREEN3 and TSCREEN Models

4.1   The maximum concentration of a toxic air contaminant from a process or process equipment
       in the ambient air may be determined by using the EPA SCREEN3 or TSCREEN models,
       using the appropriate algorithm for the type of emission release, for example, stack or
       fugitive. The maximum concentration derived from the use of one of these models, with the

221   adjustment identified in section 4.2 as appropriate, is then used in determining compliance
222   with the EA levels in Regulation 5.21 by using the applicable equation in Regulation 5.21
223   section 2.2, 2.5, or 2.8.

224   4.2   The resulting maximum concentration from the SCREEN3 or TSCREEN model is in units
225   of $\mu g/m^3$ for a 1-hour averaging time. If the averaging time for a benchmark ambient
226   concentration (BAC) for the specific toxic air contaminant as determined pursuant to
227   Regulation 5.20 is other than 1 hour, then the resulting maximum concentration shall be
228   adjusted as follows:

229   4.2.1   For a BAC with an 8-hour averaging time, multiply by 0.44,
230   4.2.1   For a BAC with a 24-hour averaging time, multiply by 0.22, and
231   4.2.1   For a BAC with an annual averaging time, multiply by 0.02.

232   4.3   The SCREEN3 model may be downloaded for free from the Internet from the EPA's web
233   page "www.epa.gov/scram001/tt22.htm#SCREEN3".

234   4.4   The TSCREEN model may be downloaded for free from the Internet from the EPA's web
235   page "www.epa.gov/scram001/tt22.htm#TSCREEN".

236   **SECTION 5   Tier 4 - EPA-Approved Dispersion Model**
237   5.1   The maximum concentration of a toxic air contaminant from a process or process equipment
238   in the ambient air may be determined by using the EPA Industrial Source Complex Model
239   (ISC3) model or another appropriate model included in Appendix A *Summaries of Preferred*
240   *Air Quality Models* of 40 CFR Part 51 Appendix W *Guideline on Air Quality Models*. The
241   maximum concentration derived from the use of one of these models is then used in
242   determining compliance with the EA levels in Regulation 5.21 by using the applicable
243   equation in Regulation 5.21 section 2.2, 2.5, or 2.8.

244   5.2   In running one of the models allowed pursuant to section 5.1, the model shall be set to report
245   the maximum concentration for the averaging time period consistent with the averaging time
246   established for the toxic air contaminant pursuant to Regulation 5.20.

247   5.3   The ISC3 model may be downloaded for free from the Internet from the EPA's web page
248   "www.epa.gov/scram001/tt22.htm#ISC".

249   Adopted v1/_____ ; effective _____.